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GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA

Open File/ Dossier publique
2294

NEWFOUNDLAND DEPARTMENT OF MINES AND ENERGY
GEOLOGICAL SURVEY BRANCH
Open File - Nfld 2062

91-02820/

GEOCHEMICAL DATA AND GOLD ASSAY RESULTS FOR SEABED SAMPLES FROM INNER-SHELF SITES OFF NORTHEAST NEWFOUNDLAND

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INTRODUCTION

This report presents the results of geochemical analyses and gold assays on samples collected from C.S.S. Hudson (cruise 90-013) in June 1990, as part of a reconnaissance survey of the inner continental shelf between White Bay and Notre Dame Bay, off northeast Newfoundland. The work forms part of the marine minerals program under the Canada-Newfoundland Mineral Development Agreement.

The sampling operations (Enclosure 1) were concentrated around the Baie Verte Peninsula, from Baie Verte to western Notre Dame Bay. Samples were also obtained in Green Bay and Halls Bay. The region surveyed had been identified as having a higher potential for hosting gold deposits than other areas of the Newfoundland shelf (Solomon, Emory-Moore and Davis, 1989). Further information on the shipboard operations can be found in the cruise report on Hudson 90-013 by Shaw and Wile (in prep.).

METHODS OF SAMPLE COLLECTION, CONCENTRATION, AND ANALYSIS

Most samples were collected using a van-Veen grab sampler. Sample 42 was collected with a large-volume, IKU clam-shell grab. Heavy-mineral concentrates (HMC's) were prepared by sieving and panning sample splits. Approximately 0.011 m^3 of each van Veen sample and 0.045 m^3 of the IKU sample were sieved to less than 2 mm and panned to produce roughly 60 g of heavy-mineral concentrate. Although samples were not dried and weighed prior to processing, approximate sample weights can be calculated assuming a bulk density of 1600 kg/m^3.

Sample analyses were carried out by Eastern Analytical Limited, Springdale, Newfoundland, under a contract between the Geological Survey of Canada and the Centre for Cold Ocean Resources Engineering. Samples of heavy mineral concentrate (30 g) and splits of whole samples were analyzed by fire assay after grinding to <80 mesh. Splits of whole samples were also analyzed for major and trace-element geochemistry using lithium metaborate fusion followed by ICP-MS.

It is important to note that the gold concentrations reported here are semi-quantitative at best. In addition, processing and analytical procedures used in other studies vary; care should be taken in comparing results with those of other studies.

RESULTS AND INTERPRETATION

The analytical results are given in Tables 1 and 2. Several samples from Baie Verte show anomalous gold values (>90 ppb in HMC) in a variety of water depths and sediment textures. The highest absolute concentration (1650 ppb in HMC) is from sample 42, which was collected with the IKU grab. However, it should be noted that the HMC from the IKU sample is equivalent to the concentration of a sample four times the size obtained using a van Veen sampler. For a fair comparison, the HMC value for the IKU sample should be divided by four, giving an equivalent gold concentration of approximately 400 ppb. Other high values have been found off the east coast of Baie Verte Peninsula, notably sample 50, with 510 ppb in HMC. (Note: 1000 ppb = 0.032 oz/ton).

Whole-sediment concentrations exceeding the detection limit were noted in samples 38 and 39 (12 and 18 ppb, respectively) in Baie Verte, sample 61 (11 ppb) in Notre Dame Bay, and sample 65 (14 ppb) in Halls Bay (Table1). Gold concentrations in whole sediment samples do not correlate with concentrations in HMC's. This is likely due to the presence of very fine (eg. clay-sized) gold particles which were washed out during panning of the whole sediment samples. Larger gold grains found in HMC's were probably missed in the whole sediment sample splits.

The detection limits for all samples was 5 ppb. This translates to approximately 0.02 ppb, in terms of the whole samples, for HMC analyses, based on a concentration factor of 280:1 (17 kg sample reduced to 60 g HMC). Therefore, heavy mineral-concentrates can be used to detect very small quantities of relatively coarse gold, while whole-sediment assays can detect only larger amounts of (possibly finer) gold.

The samples collected in Baie Verte show distinctive geochemistry, with lower concentrations of silica, zirconium, and, to a lesser extent, potassium. Mean values of chromium, magnesium, and iron are higher in Baie Verte than in other areas sampled for this study. These geochemical differences may reflect the more mafic source rocks (including ophiolites) which surround Baie Verte. Outside Baie Verte, iron and magnesium decrease with increasing silica content, whereas there is no relationship between silica and the mafic elements within Notre Dame Bay. The pattern observed outside Baie Verte may reflect input of mafic material from local sources.

In general, sediment geochemistry varies with depth as well as geographic location. Potassium and barium levels increase with depth, the former perhaps in association with increasing proportions of clay minerals such as illite. The results of four case studies reported by Buckley and Cranston (in press) underline the dominant role played by grain size in determining chemical variability, and this factor is probably a strong determinant of variability in the study area. There are no obvious relationships between any of the geochemical parameters and gold concentration.

Examples of gold concentrations measured in other marine sediments are summarized in Table 3. The gold concentrations reported here from the vicinity of the Baie Verte Peninsula compare favourably with the open Bering Sea maxima, but are two orders of magnitude lower than grades obained in areas of minable deposits. The gold found in sample 42 had a grain size of approximately 0.1 mm, similar to that of gold observed in the open Bering Sea, but an order of magnitude finer than is observed in the nearshore mining area close to Nome (Nelson and Hopkins, 1972).

Results of the initial sampling program to assess marine placer potential off Newfoundland are encouraging. Gold assay data indicate that some offshore areas in the vicinity of known onshore deposits are relatively enriched in gold.

TABLE 1: SAMPLE LOCATIONS, GOLD CONCENTRATIONS, AND DESCRIPTIONS

SAMPLE	LATITUDE (degrees)	LONGITUDE (degrees)	DEPTH (m)	Au (HMC)[a] (ppb)	Au (WS)[b] (ppb)	VOLUME (m^3)	Au[c] (mg/m^3)	DESCRIPTION	LOCATION
36	49.9385	56.1827	25	139	<5	0.011	<95	sandy mud	Baie Verte
37	49.9438	56.1658	32	<5	<5	0.111	<95	gravelly sandy mud	Baie Verte
38	49.9527	56.1528	44	<5	12	0.111	228	muddy sandy gravel	Baie Verte
39	49.9580	56.1533	54	<5	18	0.011	342	sandy mud	Baie Verte
40	49.9650	56.1547	42	97	<5	0.011	<95	sandy mud	Baie Verte
41	49.9688	56.1495	72	10	<5	0.011	<95	stiff mud	Baie Verte
42	49.9935	56.1177	43	1650	na	0.046	na	sandy gravel	Baie Verte
43	50.0080	56.1087	157	91	<5	0.011	<95	muddy gravel	Baie Verte
44	50.0167	56.1100	186	<5	<5	0.011	<95	stiff silty clay	Baie Verte
45	50.0258	56.0865	242	870	<5	0.011	<95	silty mud	Baie Verte
46	50.0237	56.0818	311	na	<5	0.011	<95	soft silty clay	Baie Verte
48	50.0377	56.0552	228	13	<5	0.011	<95	sandy mud	Baie Verte
50	49.7655	55.6390	288	510	<5	0.011	<95	silty sandy clay	Notre Dame Bay
52	49.8237	55.6008	228	<5	na	0.011	na	sandy mud	Notre Dame Bay
53	49.8645	55.5875	98	27	<5	0.011	<95	fine-medium sand	Notre Dame Bay
55	49.8413	55.4513	253	<5	<5	0.011	<95	stiff mud	Notre Dame Bay
56	49.8542	55.4478	257	<5	<5	0.011	<95	stiff silty mud	Notre Dame Bay
57	49.8858	55.4598	147	na	<5	0.011	<95	sandy gravel	Notre Dame Bay
58	49.9022	55.4520	97	<5	<5	0.011	<95	muddy coarse sand	Notre Dame Bay
59	49.8628	55.5618	150	35	<5	0.011	<95	fine sand	Notre Dame Bay
60	49.8503	55.5075	227	26	<5	0.011	<95	muddy fine sand	Notre Dame Bay
61	49.7887	55.7127	275	<5	11	0.011	209	soft mud	Notre Dame Bay
62	49.8008	55.7462	229	<5	na	0.011	na	gritty mud	Notre Dame Bay
65	49.7563	55.6605	273	<5	14	0.011	266	sandy gravelly mud	Halls Bay
66	49.7562	55.6627	277	<5	<5	0.011	<95	sandy gravelly mud	Halls Bay
67	49.7647	55.8330	292	<5	<5	0.011	<95	silty mud	Green Bay
68	50.0182	55.7670	193	<5	<5	0.011	<95	very gritty mud	Notre Dame Bay
69	50.0565	55.8120	205	<5	<5	0.011	<95	sandy gravelly mud	Notre Dame Bay
70	50.0965	55.8433	211	<5	<5	0.011	<95	very sandy mud	Notre Dame Bay

[a] HMC: heavy mineral concentrate
[b] WS: whole sediment
[c] whole sample concentration based on whole-sediment analysis

TABLE 2: GEOCHEMICAL ANALYSES OF WHOLE SAMPLES

SAMPLE	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	MgO %	CaO %	Na_2O %	K_2O %	TiO_2 %	P_2O_5 %	MnO %	Cr_2O_3 %	Ba ppm	Sr ppm	La ppm	Zr ppm	V ppm	Nb ppm
Baie Verte samples																	
36	59.46	11.91	5.82	6.96	3.40	3.51	0.69	0.70	0.14	0.10	0.139	155	176	22	70	15	30
37	56.72	12.62	5.33	5.03	3.60	3.89	1.31	0.77	0.18	0.09	0.083	295	249	17	99	15	20
38	52.92	11.63	5.97	6.53	4.11	3.67	1.01	0.79	0.27	0.09	0.131	226	199	28	71	15	20
39	52.24	11.67	5.81	5.00	4.02	3.72	1.13	0.84	0.29	0.09	0.086	298	228	11	94	19	20
40	56.51	12.08	7.24	5.46	4.83	3.42	0.97	1.12	0.16	0.11	0.090	233	199	11	77	14	26
41	52.26	11.47	5.72	4.87	4.15	3.74	1.32	0.80	0.21	0.08	0.082	302	220	10	88	13	50
43	51.34	8.32	5.71	14.84	4.43	2.14	1.07	0.44	0.18	0.08	0.200	274	138	2	62	20	8
44	52.34	10.83	4.97	3.93	4.34	3.76	1.71	0.69	0.20	0.07	0.048	464	209	31	93	13	20
45	50.90	10.05	5.07	5.51	4.36	3.76	1.76	0.60	0.23	0.07	0.072	471	214	18	93	13	20
46	49.70	10.29	4.90	3.67	3.88	4.06	2.07	0.59	0.22	0.07	0.043	506	213	20	85	15	20
48	56.98	10.64	5.20	6.52	4.02	3.05	1.69	0.64	0.16	0.08	0.111	433	198	11	99	15	24
mean	53.76	11.05	5.61	6.21	4.10	3.52	1.34	0.73	0.20	0.08	0.10	332.45	203.91	16.45	84.64	15.18	24.00
std. dev.	2.97	1.14	0.63	2.90	0.38	0.50	0.40	0.17	0.04	0.01	0.04	111.34	27.45	8.15	12.15	2.21	11.35
Samples from outside Baie Verte																	
50	58.50	11.22	4.62	3.19	3.03	3.71	2.27	0.68	0.23	0.06	0.049	532	215	34	149	19	20
53	69.92	11.62	4.17	1.95	2.38	3.20	2.43	0.90	0.23	0.07	0.047	438	172	20	239	24	20
55	64.27	11.16	4.12	3.30	3.12	3.19	2.04	0.69	0.16	0.06	0.065	544	219	2	172	17	33
56	64.81	11.14	3.92	3.21	2.93	3.20	2.27	0.67	0.19	0.06	0.072	590	221	25	180	16	20
57	75.11	8.86	3.30	2.22	2.31	2.46	1.38	0.53	0.15	0.05	0.063	360	145	28	114	15	44
58	66.58	12.52	4.53	3.37	3.22	3.38	1.61	0.63	0.12	0.07	0.045	1264	209	2	97	15	20
59	70.01	12.01	3.66	2.07	2.31	3.40	2.41	0.83	0.18	0.07	0.042	455	186	18	194	26	20
60	68.09	11.19	3.71	3.50	3.13	3.11	1.97	0.65	0.15	0.06	0.061	416	184	13	163	19	20
61	58.18	11.37	4.76	3.16	3.02	3.88	2.24	0.70	0.24	0.07	0.055	551	214	12	143	14	20
65	60.33	11.96	4.76	3.47	5.78	2.81	2.19	0.52	0.14	0.10	0.050	526	214	13	137	14	20
66	46.38	10.11	4.80	4.85	12.64	2.53	1.61	0.43	0.21	0.07	0.051	416	294	8	70	9	20
67	62.35	11.12	4.58	2.91	3.46	3.40	2.21	0.65	0.16	0.07	0.057	518	216	56	148	19	20
68	65.34	11.03	3.51	2.78	3.96	3.11	1.79	0.66	0.18	0.05	0.061	527	247	5	245	10	20
69	69.94	10.17	3.28	2.10	2.78	2.93	1.63	0.69	0.14	0.05	0.045	724	219	2	231	13	20
70	70.83	9.86	3.17	1.93	2.87	2.87	1.72	0.72	0.18	0.05	0.055	568	213	25	226	15	20
mean	64.71	11.02	4.06	2.93	3.80	3.15	1.98	0.66	0.18	0.06	0.05	561.93	211.20	17.53	167.20	16.33	22.47
std. dev.	6.76	0.90	0.57	0.76	2.50	0.38	0.32	0.11	0.04	0.01	0.01	205.90	32.36	14.19	51.03	4.44	6.60

Location	Concentration (ppb)	Type
Country harbour, Nova Scotia[1]	> 50	whole-sediment
	4250	whole sediment maximum
Offshore North Carolina[2]	6.9	whole sediment maximum
	2300	HMC maximum
Offshore Klamath Mts., Ca.[3]	<10	whole sediment background
	390	whole sediment maximum
Gulf of Alaska beaches[4]	1870	whole sediment maximum
Nearshore & beach, Nome, Alaska[5]	2500	whole sediment maximum (till)
	12	whole sediment maximum (outwash)
	1910	whole sediment maximum (beach gravel)
Open Bering Sea[5]	38	whole sediment maximum (relict moraine)
	182	whole sediment maximum (sand and mud)
Westgold mining operation, off Nome, Alaska[6]	1813	ore grade (2900 mg/m^3 = 0.058 oz/ton)

[1] Emory-Moore, 1985; [2] Pilkey and Bornhold, 1970; [3] Moore and Silver, 1968; [4] Reimnitz and Plafker, 1976; [5] Nelson and Hopkins 1972; [6] Bosse, 1990.

Table 3: Examples of gold concentrations measured in marine sediments. Methods for concentration and analysis used in these studies vary, and caution should be exercised when comparing them with each other and with the data reported here. (Note, 1000 ppb = 0.032 oz/ton).

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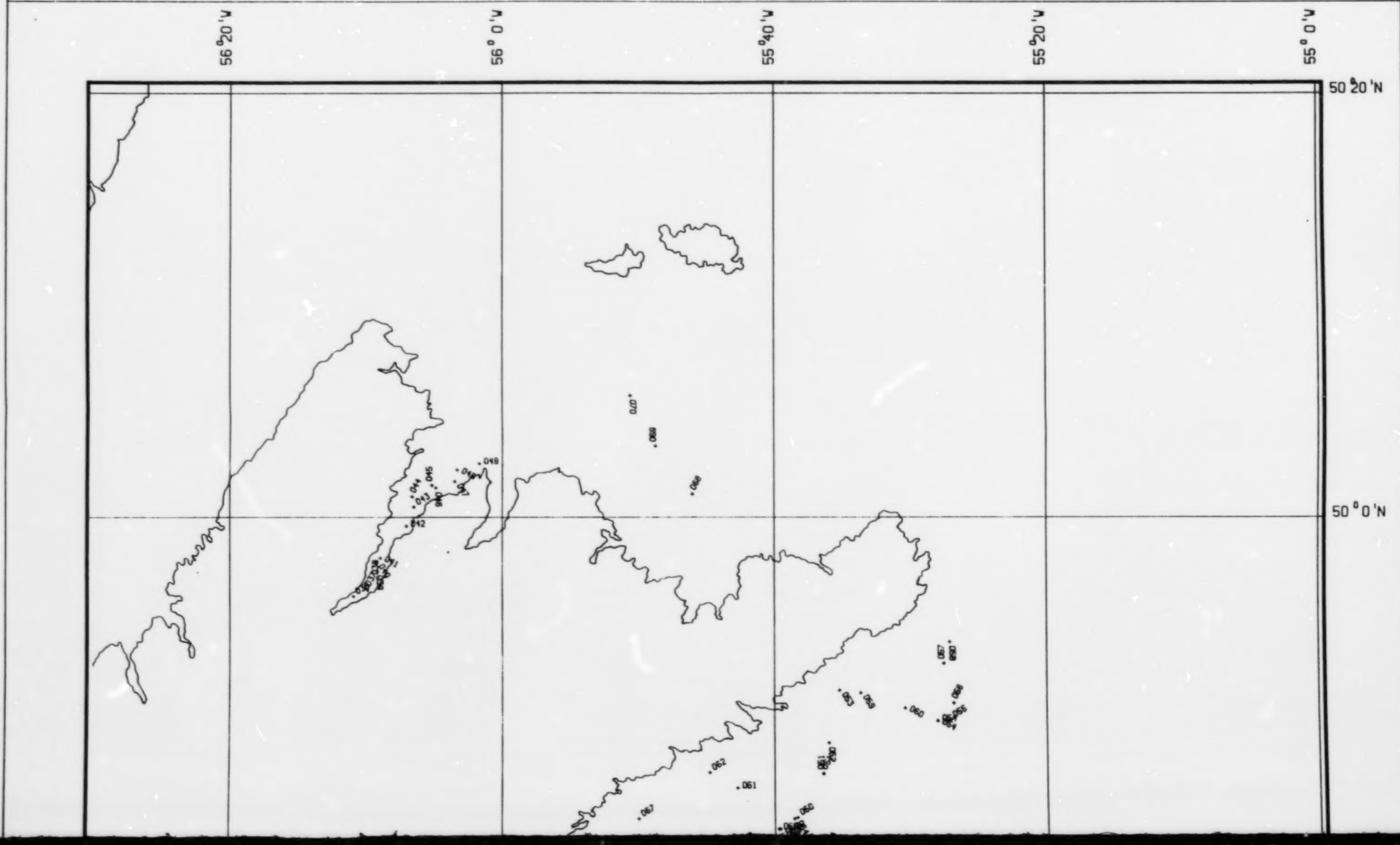
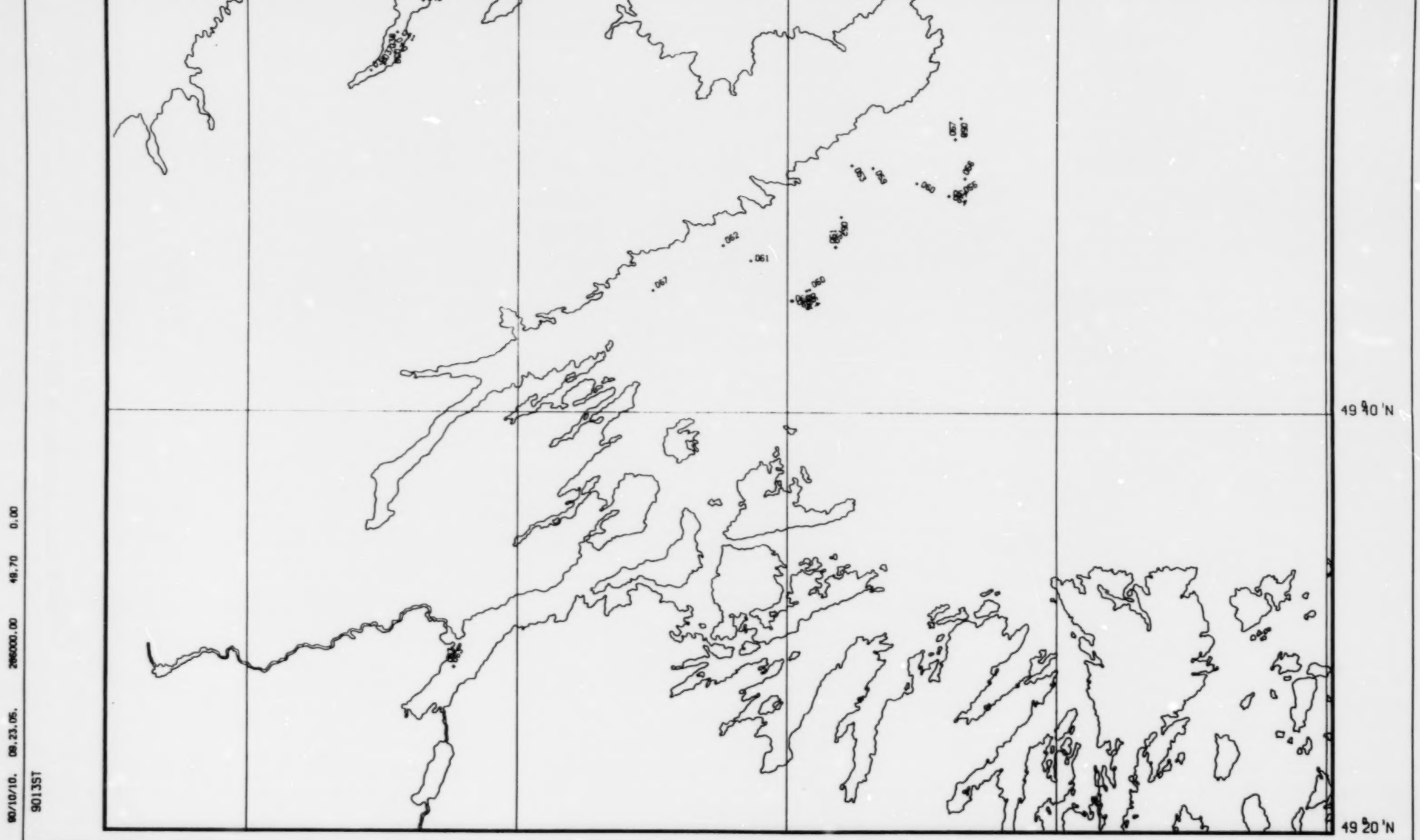
90-013 SAMPLE LOCATIONS
1:286,000 AT 49.70N





ATLANTIC GEOSCIENCE CENTRE

ENCLOSURE 1

Shaw, J., Solomon, S.M., Emory-Moore, M., Forbes, D.L. and Proudfoot, D.N. 1990